

Integrated Multi-Trophic Aquaculture

A New Era for Aquaculture in Canada?

Why IMTA?

Over the past few decades, fish capture from aquaculture accounted for 46% of global fish production in 2018¹, continuously growing to match the needs and demands for animal proteins. Integrated Multi-Trophic Aquaculture (IMTA) is an aquaculture approach that can improve the environmental and economic impacts as well as the social implications of aquaculture while also increasing productivity. However IMTA in Canada is still in the research and development stage. With the increasing industry of aquaculture in Canada, policies must be created that further support ongoing IMTA research to integrate it to large-scale aquaculture operations.

What is IMTA?

IMTA simulates the natural food chain and interactions between marine species of different trophic levels such that harvesting can occur across multiple species at a single site or operation. Open-water aquaculture of finfish like salmon can cause many harmful impacts to the environment, such as effluent and wastewater polluting the surrounding environments. With IMTA, these outputs can be recycled as inputs to other harvestable species, such as shellfish or molluscs, lessening impacts to the environment and increasing food-conversion rate efficiency. Figure 1 shows a conceptual diagram of IMTA which demonstrates the recycling of outputs from one species as inputs to another species.

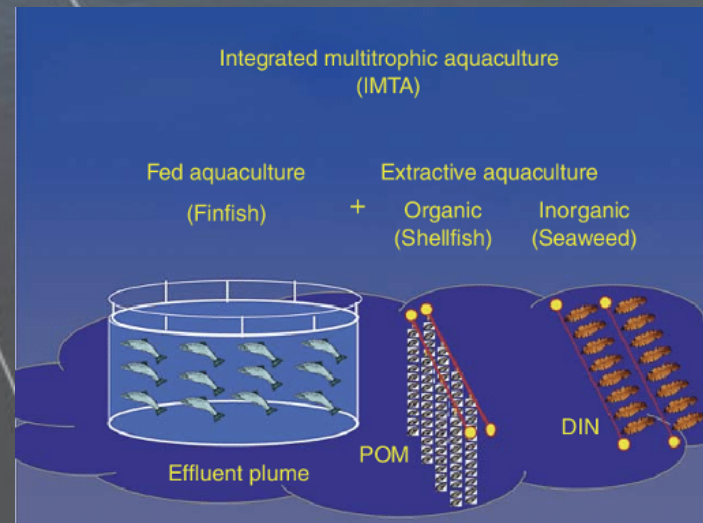


Figure 1. A conceptual diagram of an IMTA system. POM: Particulate organic matter. DIN: Dissolved inorganic nutrients²

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CASE STUDY A BC sablefish aquaculture operation in Vancouver Island is a part of a current research program looking to incorporate IMTA methods to a commercial scale³.
Kyuquot SEAfoods Ltd.

Sablefish

Shellfish

Sea Cucumber

Kelp

-  Shellfish cultivating infrastructure was **successfully** incorporated into sablefish cages for **efficient** water column utilization and **reduced** maintenance costs
-  Sea cucumbers **effectively** consumed sablefish waste (fecal matter), resulting in **high** growth rates
-  Kelp production allowed for **availability** of inorganic nitrogen to the system throughout most of the year, **increasing** productivity

1. FAO. (2020). The State of World Fisheries and Aquaculture 2020. Food and Agriculture Organization of the United Nations. Available at: <http://www.fao.org/3/ca9229en/ca9229en.pdf>
2. Chopin, T., Robinson, S. M. C., Troell, M., Neori, A., Buschmann, A. H., & Fang, J. Multitrophic integration for sustainable marine aquaculture. (pp. 2463-2475). Elsevier B.V.
3. Government of Canada. (2012). Aquaculture Collaborative Research and Development Program (ACRDP) Fact Sheet. Available at: <https://www.dfo-mpo.gc.ca/aquaculture/acrdp-pcrda/fsheet-ftechnique/issue-fiche-11-eng.html>

What are the benefits of IMTA?

Economy

- Additional profits from harvesting multiple species compared to monoculture farms⁴
- Decreased economic risk when taking into account variability in production and market condition⁵

Environment

- Recycling nutrients and wastes have implications for sustainability such as:
 - Decreased risk of algal blooms
 - Less impacts to benthic organisms
- Potential for species like mussels to fight pathogens associated with monoculture⁶

Society

- IMTA can improve public perception on aquaculture⁷
- IMTA is seen by the public as more 'natural', and there is a potential to pay more for IMTA premium products⁴

Current monoculture operations for finfish are generally not well-perceived by the public because of the implications of effects to the environment. However, there are massive benefits that can be gained through the integration of IMTA to Canadian aquaculture operations that are more environmentally sustainable. This will also encourage the growth of the aquaculture sector through increased production and by being more appealing to local consumers.



Recommendations

- **Fund** IMTA research initiatives such as the Canadian Integrated Multi-Trophic Aquaculture Network
- **Amend** current aquaculture regulations to allow operators to hold multiple licenses for different species at the same site
- **Encourage** commercial and industrial aquaculture operations to participate in IMTA research for large-scale implementation

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4. Knowler, D., Chopin, T., Marinez-Espineira, R. Neori, A., Nobre, A., Noce, A., Reid, G. (2019). The economics of Integrated Multi-Trophic Aquaculture: where are we now and where do we need to go? *Reviews in Aquaculture*, 1-16.

5. Ridler, N., Wowchuk, M., Robinson, B., Barrington, K., Chopin, T., Robinson, S., Page, F., Reid, G., Szemerda, M., Sewuster, J., & Boyne-Travis, S. (2007). integrated multi – trophic aquaculture (imta): A potential strategic choice for farmers. *Aquaculture Economics & Management*, 11(1), 99-110

6. Government of Canada. (2017). Pathogen Depletion by Cultured Mussels: Investigating the Further Benefits of Integrated Multitrophic Aquaculture. Available at: <https://www.dfo-mpo.gc.ca/aquaculture/rp-pr/acrdp-pcrda/projects-projets/MG-07-04-005-eng.html>

7. Ridler, N., Robinson, B., Chopin, T., Robinson, S., Page, F. (2006). Development of integrated multi-trophic aquaculture in the Bay of Fundy,